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3D-Seismic and Acoustic Imaging of Intense Faulting and associated Gas Migration Pathways Beneath Pockmarks in Hemipelagic Sediments off Congo, SW Africa

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Seismic and acoustic imaging is a major tool to study basic geological parameters controlling the migration and trapping of gas, the occurrence of gas hydrate as well as of free gas beneath and within the gas hydrate stability field. For sufficient gas accumulations, upward flow can occur along pre-determined zones of weakness and conduits of high permeability or with fluidized material.

In the hemipelagic sedimentary sequences off the Congo, where layering and uniform properties exist at the time of deposition, modification of sediment physical properties due to mixing between water, gas and hydrates within pore spaces affects amplitude and phase properties of seismic reflections. Furthermore, fluid flow and gas or hydrate accumulations are often associated with sediment deformation or faulting on different scales.

Thus, an integrated interpretation of seismic, acoustic, and surface mapping data sets was used to optimize lateral and vertical resolution at each depth level and to connect deeper processes to their surface expressions. 3D seismic data across seafloor pockmarks indicate that the typical low-amplitude signature of opal-rich and water-rich sediments is superimposed by high amplitude zones near faults and potential fluid pathways. A high amplitude patch observed in 40-50 m depth is interpreted as a gas hydrate cap that plugs the feeder channel of a pockmark and initiates hydrate growth parallel to the bedding. The upflow zone at greater depth is characterized by amplitude blanking, indicating free gas bubbles that scatter seismic energy. A package of high amplitude reflector elements at 150-200 m sub-bottom depth suggests the pres-

ence of trapped gas beneath a low permeable layer. This package is bent upwards at the vicinity of the pockmark, probably indicating a deeper salt diapir, that is associated with faulting and probably higher permeability above the diapir. However, the creation of pathways beneath the pockmarks is not yet completely understood. Preliminary results based on 3D mapping of fault plane orientations suggest that faulting due to diapirism may be superimposed by zones of weakness within a regional fault pattern that probably is of polygonal structure.